Office of Energy Efficiency and Renewable Energy

# Near-Frictionless Carbon Film Coating

## Background

Coatings applied to engine components that slide, roll, or rotate reduce friction, increase engine durability, and improve performance. It is often difficult, time-consuming, or expensive to apply these coatings to all types and shapes of automotive parts – such as those made of plastic, ceramic, or certain metals. And the coatings may not be durable enough to hold up to the heat and friction encountered in today's engines.

## Accomplishments

- Argonne National Laboratory has developed a near-frictionless carbon (NFC) film coating many times slicker than Teflon®. The new material's coefficient of friction is less than 0.001 when measured in a dry nitrogen atmosphere (Teflon's coefficient of friction is around 0.04).
- Thin (1-micrometer) NFC films can be deposited on virtually any substrate by ion-beam deposition, sputtering, or chemical vapor deposition at low temperatures (room temperature to 200°C) without risking damage to heat-sensitive materials.
- The most promising applications for the coating are automobile and engine parts – turbocharger rotors, piston rings, gears and bearings, air-conditioning compressors, and fuel injector components.
- In addition to being named an R&D 100 Award winner, the NFC coating was a finalist in the "Emerging Technology" category of the 1998 Discover Magazine Awards.

## Benefits

- NFC has exceptional wear resistance and durability that reduce material and energy losses.
- The new process is quick – it takes only a few hours – and is scalable to large batch production runs.
- The material adheres well to many kinds of substrates, including plastics.
- Near-perfect finished products have a smooth surface, uniform coverage, and good transparency; they do not require secondary machining or grinding.
- The ultrahard coating means longer lifetime and improved performance in rolling, sliding, and rotating components.
- Extremely slick coatings are ideal for sliding parts and machining of high-precision surfaces.
- The coatings offer higher productivity, lower costs, and improved environmental compliance (reduction or elimination of flammable and hazardous metalworking fluids).

## Future Activites

- Develop processes for depositing NFC films on metal and ceramic components.
- Test the performance of the films over a wide range of loads, speeds, and temperatures to reduce friction and improve wear and corrosion properties.
- Optimize tooling and process conditions to coat large batches of components at low cost.

## Partners in Success

Argonne National Laboratory
Diesel Technology Company
Front Edge Technology, Inc.
Stirling Motors, Inc.

## Contact

JoAnn Milliken: (202) 586-2480

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